

WHAT IS CLAIMED IS:

1. An apparatus for analyzing light having at least one wavelength, the apparatus comprising:

(a) a light deflector for deflecting the light so as to provide a deflected light beam characterized by at least one wavelength-dependent angle, respectively, corresponding to the at least one wavelength of the light;

(b) an encoder, capable of encoding said deflected light beam so as to provide an encoded light beam characterized by at least one angle-dependent polarization state, respectively, corresponding to said at least one wavelength-dependent angle; and

(c) a decoder, for decoding said encoded light beam so as to determine at least one spectral component of the light.

2. The apparatus of claim 1, further comprising:

(d) a mechanism for varying at least one parameter representing at least one of said light deflector and said encoder so as to span a discrete basis of signals, each corresponding to one value of said at least one parameter.

3. The apparatus of claim 2, wherein said decoder is operable to use said discrete basis of signals for determining said at least one spectral component of the light.

4. The apparatus of claim 1, further comprising a beam splitter, for splitting the light into two beams, each having a predetermined polarization.

5. The apparatus of claim 4, wherein said beam splitter comprises a double refraction plate.

6. The apparatus of claim 1, further comprising at least one polarization rotator, designed and configured so as to rotate a polarization of said deflected light beam and/or a polarization of said encoded light beam.

7. The apparatus of claim 1, wherein said light deflector is selected from the group consisting of a grating and a prism.

8. The apparatus of claim 7, wherein said grating is characterized by a first grating equation in a first dimension and a second grating equation in a second dimension.

9. The apparatus of claim 1, wherein said wavelength-dependent angle is characterized by a predetermined dispersion equation.

10. The apparatus of claim 1, wherein said encoder is operable to generate at least one angle-dependent polarization phase-shift, thereby to provide said angle-dependent polarization state.

11. The apparatus of claim 10, wherein said encoder is calibrated so as to generate a zero or small polarization phase-shift for a predetermined set of wavelengths and a non-zero polarization phase-shift for wavelengths other than said predetermined set of wavelengths.

12. The apparatus of claim 11, wherein said predetermined set of wavelengths comprises a central wavelength and a repetitive set of wavelengths being associated with said central wavelength.

13. The apparatus of claim 10, wherein said polarization phase-shift is selected so as to minimize diffraction effects.

14. The apparatus of claim 10, wherein said angle-dependent polarization phase-shift varies with time.

15. The apparatus of claim 10, wherein said encoder comprises at least one geometrical crystal filter characterized by at least one angle-dependent index of refraction.

16. The apparatus of claim 15, further comprising a first mechanism for varying said angle-dependent polarization phase-shift.

17. The apparatus of claim 16, wherein said first mechanism is operable to rotate said at least one geometrical crystal filter about an axis, so as to vary said angle-dependent polarization phase-shift.

18. The apparatus of claim 17, further comprising a first polarization rotator, for rotating a polarization of said deflected light beam from a first polarization orientation to a second polarization orientation.

19. The apparatus of claim 18, wherein said first polarization rotator is designed and constructed such that said second polarization orientation substantially equals an orientation of said at least one geometrical crystal filter.

20. The apparatus of claim 19, further comprising a second polarization rotator, for rotating a polarization of said encoded light beam from said second polarization orientation to said first polarization orientation.

21. The apparatus of claim 16, wherein said first mechanism is operable to generate a further deflection of the deflected light beam, said further deflection being time-dependent so that said angle-dependent polarization phase-shift varies.

22. The apparatus of claim 21, wherein said first mechanism is a mirror.

23. The apparatus of claim 16, wherein said first mechanism is operable to vary an effective length of said at least one geometrical crystal filter, thereby to vary said angle-dependent polarization phase-shift.

24. The apparatus of claim 23, wherein said first mechanism is capable of applying a voltage on said at least one geometrical crystal filter, thereby to vary said effective length.

25. The apparatus of claim 23, wherein a shape of said at least one geometrical crystal filter is selected such that when said first mechanism applies a translational motion thereto, said effective length is varied.

26. The apparatus of claim 16, wherein said light deflector is a dynamic grating characterized by a grating equation and further wherein said first mechanism is operable to vary said grating equation, thereby to vary said wavelength-dependent angle, thereby also to vary said angle-dependent polarization phase-shift.

27. The apparatus of claim 15, wherein said at least one geometrical crystal filter is selected from the group consisting of a birefringent crystal and quartz.

28. The apparatus of claim 27, wherein said birefringent crystal is calcite.

29. The apparatus of claim 15, wherein said at least one geometrical crystal filter is selected from the group consisting of at least one on-axis crystal, at least one off-axis crystal and a combination of at least one on-axis crystal and at least one off-axis crystal.

30. The apparatus of claim 1, further comprising a collimator for collimating the light, prior to an impingement of the light on said light deflector.

31. The apparatus of claim 15, further comprising at least one additional geometrical crystal filter, for polarizing the light prior to impinging of the light on said light deflector.

32. The apparatus of claim 1, wherein said decoder is capable of splitting said encoded light beam into two secondary polarized light beams, and calculating a contrast function between said two secondary polarized light beams.

33. The apparatus of claim 1, wherein said decoder is capable of generating a representative time-delay for each of said angle-dependent polarization state, and

using said representative time-delay for determining said at least one spectral component of the light.

34. The apparatus of claim 33, wherein said decoder comprises:

(i) a temporal polarization phase-shifter, communicating with an external clock, and capable of accumulating a time-dependent polarization phase-shift to said encoded light beam; and

(ii) a polarization phase-shift analyzer, capable of analyzing said time-dependent polarization phase-shift so as to provide an optical signal having a time-dependent intensity, corresponding to said time-dependent polarization phase-shift.

35. The apparatus of claim 34, wherein said temporal polarization phase-shifter is selected from the group consisting of a liquid crystal light valve and a piezoelectric crystal.

36. The apparatus of claim 35, wherein said piezoelectric crystal is a single resonance piezoelectric crystal.

37. The apparatus of claim 35, wherein said piezoelectric crystal is a multi resonance piezoelectric crystal.

38. The apparatus of claim 35, wherein said piezoelectric crystal is selected from the group consisting of a cubic piezoelectric crystal, a triangular piezoelectric crystal and a hexagonal crystal.

39. The apparatus of claim 35, wherein said piezoelectric crystal is selected from the group consisting of quartz, lithium niobate and lithium tantalate.

40. The apparatus of claim 34, wherein said decoder further comprises an optical converter, for converting said optical signal to electrical signal.

41. The apparatus of claim 40, wherein said optical converter is selected from the group consisting of a charge coupled device, a CMOS detector, a

photovoltaic detector, a pin detector, a photodiode, a charge injection device, an image intensifier, a photoconductor detector, an avalanche detector, a photomultiplier and any combination thereof.

42. The apparatus of claim 1, further comprising at least one filter for filtering a portion of the light, prior to an impingement on said deflector, said encoder and/or said decoder.

43. The apparatus of claim 1, further comprising a first anamorphic prism, positioned so as to reduce a spot size of the light prior to impingement of the light on said deflector.

44. The apparatus of claim 1, further comprising a second anamorphic prism, positioned so as to increase angular dispersion of said deflected light beam, prior to impingement of said deflected light beam on said decoder, thereby to optimize a wavelength resolution.

45. The apparatus of claim 1, further comprising a low-resolution optical device, for determining a low-resolution spectral range of the light.

46. The apparatus of claim 15, further comprising a low-resolution optical device, for determining a low-resolution spectral range of the light.

47. The apparatus of claim 46, wherein said low-resolution optical device comprises an additional geometrical crystal filter, and further wherein a free spectral range of said additional geometrical crystal filter is different than a free spectral range of said at least one geometrical crystal filter.

48. The apparatus of claim 47, wherein said free spectral range of said additional geometrical crystal filter is substantially larger than said free spectral range of said at least one geometrical crystal filter.

49. The apparatus of claim 45, wherein said low-resolution optical device is capable of directly using said at least one wavelength-dependent angle so as to determine said low-resolution spectral range.

50. The apparatus of claim 49, wherein said low-resolution optical device is a position sensing device, whereby a position of said deflected light beam corresponds to a respective wavelength-dependent angle.

51. The apparatus of claim 49, wherein said low-resolution optical device is selected from the group consisting of a charge coupled device, a CMOS detector, a photovoltaic detector, a pin detector, a photodiode, a charge injection device, an image intensifier, a photoconductor detector, an avalanche detector and a photomultiplier.

52. The apparatus of claim 1, characterized by a sub picometer resolution.

53. The apparatus of claim 1, characterized by a sub nanometer resolution.

54. The apparatus of claim 1, wherein a total analysis time of the light is from about 1 nanosecond to a few hours.

55. The apparatus of claim 1, characterized by a detectivity of from about -80 db to about -0 db.

56. The apparatus of claim 1, serving as a component in a wavelength amplifying system.

57. The apparatus of claim 1, serving as a component in an optical sensor.

58. The apparatus of claim 1, serving as a component in a spectrograph.

59. The apparatus of claim 1, serving as a component in an imaging spectrograph.

60. The apparatus of claim 1, serving as a component in a time-frequency spectrograph.

61. The apparatus of claim 1, serving as a component in a telecentric imaging system.

62. The apparatus of claim 1, serving as a component in an optical storage medium.

63. The apparatus of claim 1, serving as a component in an optical communication system.

64. The apparatus of claim 1, serving as a component in a tunable laser system.

65. The apparatus of claim 1, serving as a component in a lithography system.

66. The apparatus of claim 1, serving as a component in an optical computing system.

67. The apparatus of claim 1, serving as a component in a fiber Bragg sensor.

68. The apparatus of claim 1, serving for stabilizing laser radiation.

69. The apparatus of claim 1, serving for monitoring optical pulses.

70. The apparatus of claim 1, serving for modulating a light source.

71. The apparatus of claim 1, serving for discriminating between Raman emission and fluorescence.

72. The apparatus of claim 1, serving for discriminating between different light sources.

73. The apparatus of claim 1, serving for testing a multi-lasers test system.

74. The apparatus of claim 1, serving for generating frequency multiplexed signals.

75. The apparatus of claim 1, serving for sensing changes in environmental conditions, influencing said deflected light beam and/or said encoded light beam.

76. The apparatus of claim 1, wherein said changes in said environmental conditions are selected from the group consisting of vibrations, changes in temperature, changes in pressure, changes in magnetic field and changes in electric field.

77. An apparatus for measuring a wavelength of a monochromatic light, the apparatus comprising:

(a) a light deflector for deflecting the monochromatic light at a wavelength-dependent angle;

(b) an encoder, capable of encoding the monochromatic light according to said wavelength-dependent angle thereby to provide an encoded light beam; and

(c) a decoder, for decoding said encoded light beam so as to determine the wavelength of a monochromatic light.

78. The apparatus of claim 77, further comprising:

(d) a mechanism for varying at least one parameter representing at least one of said light deflector and said encoder and repeating said steps (a)-(b) at least one so as to span a discrete basis of signals, each corresponding to one value of said at least one parameter.

79. The apparatus of claim 78, wherein said decoder is operable to use said discrete basis of signals for determining the wavelength of a monochromatic light.

80. The apparatus of claim 77, further comprising a beam splitter, for splitting the monochromatic light into two beams, each having a predetermined polarization.

81. The apparatus of claim 80, wherein said beam splitter comprises a double refraction plate.

82. The apparatus of claim 80, further comprising at least one polarization rotator, designed and configured so as to rotate a polarization of said deflected light beam and/or a polarization of said encoded light beam.

83. The apparatus of claim 77, wherein said light deflector is selected from the group consisting of a grating and a prism.

84. The apparatus of claim 77, wherein said wavelength-dependent angle is characterized by a predetermined dispersion equation.

85. The apparatus of claim 77, wherein said encoder is operable to generate at least one angle-dependent polarization phase-shift, thereby to provide said angle-dependent polarization state.

86. The apparatus of claim 85, wherein said encoder is calibrated so as to generate a zero or small polarization phase-shift for a predetermined set of wavelengths and a non-zero polarization phase-shift for wavelengths other than said predetermined set of wavelengths.

87. The apparatus of claim 86, wherein said predetermined set of wavelengths comprises a central wavelength and a repetitive set of wavelengths being associated with said central wavelength.

88. The apparatus of claim 85, wherein said polarization phase-shift is selected so as to minimize diffraction effects.

89. The apparatus of claim 85, wherein said encoder comprises at least one geometrical crystal filter characterized by at least one angle-dependent index of refraction.

90. The apparatus of claim 89, wherein said at least one geometrical crystal filter is selected from the group consisting of a birefringent crystal and quartz.

91. The apparatus of claim 90, wherein said birefringent crystal is calcite.

92. The apparatus of claim 89, wherein said at least one geometrical crystal filter is selected from the group consisting of at least one on-axis crystal, at least one off-axis crystal and a combination of at least one on-axis crystal and at least one off-axis crystal.

93. The apparatus of claim 77, further comprising a collimator for collimating the monochromatic light, prior to an impingement of the monochromatic light on said light deflector.

94. The apparatus of claim 89, further comprising at least one additional geometrical crystal filter, for polarizing the monochromatic light prior to impinging of the monochromatic light on said light deflector.

95. The apparatus of claim 77, wherein said decoder is capable of splitting said encoded light beam into two secondary polarized light beams, and calculating a contrast function between said two secondary polarized light beams.

96. The apparatus of claim 77, wherein said decoder is capable of generating a representative time-delay for each of said angle-dependent polarization state, and using said representative time-delay for determining the wavelength of the monochromatic light.

97. The apparatus of claim 96, wherein said decoder comprises:

(i) a temporal polarization phase-shifter, communicating with an external clock, and capable of accumulating a time-dependent polarization phase-shift to said encoded light beam; and

(ii) a polarization phase-shift analyzer, capable of analyzing said time-dependent polarization phase-shift so as to provide an optical signal having a time-dependent intensity, corresponding to said time-dependent polarization phase-shift.

98. The apparatus of claim 97, wherein said temporal polarization phase-shifter is selected from the group consisting of a liquid crystal light valve and a piezoelectric crystal.

99. The apparatus of claim 98, wherein said piezoelectric crystal is a single resonance piezoelectric crystal.

100. The apparatus of claim 98, wherein said piezoelectric crystal is a multi resonance piezoelectric crystal.

101. The apparatus of claim 98, wherein said piezoelectric crystal is selected from the group consisting of a cubic piezoelectric crystal, a triagonal piezoelectric crystal and a hexagonal crystal.

102. The apparatus of claim 98, wherein said piezoelectric crystal is selected from the group consisting of quartz, lithium niobate and lithium tantalate.

103. The apparatus of claim 97, wherein said decoder further comprises an optical converter, for converting said optical signal to electrical signal.

104. The apparatus of claim 103, wherein said optical converter is selected from the group consisting of a charge coupled device, a CMOS detector, a photovoltaic detector, a pin detector, a photodiode, a charge injection device, an image intensifier, a photoconductor detector, an avalanche detector, a photomultiplier and any combination thereof.

105. The apparatus of claim 77, further comprising at least one filter for filtering a portion of the monochromatic light, prior to an impingement on said deflector, said encoder and/or said decoder.

106. The apparatus of claim 77, further comprising a first anamorphic prism, positioned so as to reduce a spot size of the monochromatic light prior to impingement of the monochromatic light on said deflector.

107. The apparatus of claim 77, further comprising a second anamorphic prism, positioned so as to increase angular dispersion of said deflected light beam, prior to impingement of said deflected light beam on said decoder, thereby to optimize a wavelength resolution.

108. The apparatus of claim 77, further comprising a low-resolution optical device, for determining a low-resolution spectral range of the monochromatic light.

109. The apparatus of claim 89, further comprising a low-resolution optical device, for determining a low-resolution spectral range of the monochromatic light.

110. The apparatus of claim 109, wherein said low-resolution optical device comprises an additional geometrical crystal filter, and further wherein a free spectral range of said additional geometrical crystal filter is different than a free spectral range of said at least one geometrical crystal filter.

111. The apparatus of claim 110, wherein said free spectral range of said additional geometrical crystal filter is substantially larger than said free spectral range of said at least one geometrical crystal filter.

112. The apparatus of claim 108, wherein said low-resolution optical device is capable of directly using said at least one wavelength-dependent angle so as to determine said low-resolution spectral range.

113. The apparatus of claim 112, wherein said low-resolution optical device is a position sensing device, whereby a position of said deflected light beam corresponds to a respective wavelength-dependent angle.

114. The apparatus of claim 112, wherein said low-resolution optical device is selected from the group consisting of a charge coupled device, a CMOS detector, a photovoltaic detector, a pin detector, a photodiode, a charge injection device, an image intensifier, a photoconductor detector, an avalanche detector and a photomultiplier.

115. The apparatus of claim 77, characterized by a sub picometer resolution.

116. The apparatus of claim 77, characterized by a sub nanometer resolution.

117. The apparatus of claim 77, wherein a total analysis time of the monochromatic light is from about 1 nanosecond to a few hours.

118. The apparatus of claim 77, characterized by a detectivity of from about -80 db to about -0 db.

119. The apparatus of claim 77, serving as a component in a wavelength amplifying system.

120. The apparatus of claim 77, serving as a component in an optical sensor.

121. The apparatus of claim 77, serving as a component in an optical storage medium.

122. The apparatus of claim 77, serving as a component in a tunable laser system.

123. The apparatus of claim 77, serving as a component in an optical computing system.

124. The apparatus of claim 77, serving for sensing changes in environmental conditions, influencing said wavelength-dependent angle and/or said encoded light beam.

125. The apparatus of claim 124, wherein said changes in said environmental conditions are selected from the group consisting of vibrations, changes in temperature, changes in pressure, changes in magnetic field and changes in electric field.

126. A communications system having a multiplexing apparatus for generating an optical signal characterized by a plurality of wavelengths and a demultiplexing apparatus, for extracting said information from the optical signal, the demultiplexing apparatus comprising:

(a) a light deflector for deflecting the light so as to provide a deflected light beam characterized by a plurality of wavelength-dependent angles, respectively, corresponding to the plurality of wavelengths of the optical signal;

(b) an encoder, capable of encoding said deflected light beam so as to provide an encoded light beam characterized by a plurality of angle-dependent polarization states, respectively, corresponding to said plurality of wavelength-dependent angles; and

(c) a decoder, for decoding said encoded light beam so as to determine the plurality of wavelengths of the optical signal.

127. The system of claim 126, further comprising:

(d) a mechanism for varying at least one parameter representing at least one of said light deflector and said encoder so as to span a discrete basis of signals, each corresponding to one value of said at least one parameter.

128. The system of claim 127, wherein said decoder is operable to use said discrete basis of signals for determining the plurality of wavelengths of the optical signal.

129. The system of claim 126, further comprising a beam splitter, for splitting the light into two beams, each having a predetermined polarization.

130. The system of claim 129, wherein said beam splitter comprises a double refraction plate.

131. The system of claim 129, further comprising at least one polarization rotator, designed and configured so as to rotate a polarization of said deflected light beam and/or a polarization of said encoded light beam.

132. The system of claim 126, wherein said light deflector is selected from the group consisting of a grating and a prism.

133. The system of claim 132, wherein said grating is characterized by a first grating equation in a first dimension and a second grating equation in a second dimension.

134. The system of claim 126, wherein said wavelength-dependent angle is characterized by a predetermined dispersion equation.

135. The system of claim 126, wherein said encoder is operable to generate at least one angle-dependent polarization phase-shift, thereby to provide said angle-dependent polarization state.

136. The system of claim 135, wherein said encoder is calibrated so as to generate a zero or small polarization phase-shift for a predetermined set of wavelengths and a non-zero polarization phase-shift for wavelengths other than said predetermined set of wavelengths.

137. The system of claim 136, wherein said predetermined set of wavelengths comprises a central wavelength and a repetitive set of wavelengths being associated with said central wavelength.

138. The system of claim 135, wherein said polarization phase-shift is selected so as to minimize diffraction effects.

139. The system of claim 135, wherein said angle-dependent polarization phase-shift varies with time.

140. The system of claim 135, wherein said encoder comprises at least one geometrical crystal filter characterized by at least one angle-dependent index of refraction.

141. The system of claim 140, further comprising a first mechanism for varying said angle-dependent polarization phase-shift.

142. The system of claim 141, wherein said first mechanism is operable to rotate said at least one geometrical crystal filter about an axis, so as to vary said angle-dependent polarization phase-shift.

143. The system of claim 142, further comprising a first polarization rotator, for rotating a polarization of said deflected light beam from a first polarization orientation to a second polarization orientation.

144. The system of claim 143, wherein said first polarization rotator is designed and constructed such that said second polarization orientation substantially equals an orientation of said at least one geometrical crystal filter.

145. The system of claim 144, further comprising a second polarization rotator, for rotating a polarization of said encoded light beam from said second polarization orientation to said first polarization orientation.

146. The system of claim 141, wherein said first mechanism is operable to generate a further deflection of the deflected light beam, said further deflection being time-dependent so that said angle-dependent polarization phase-shift varies.

147. The system of claim 146, wherein said first mechanism is a mirror.

148. The system of claim 141, wherein said first mechanism is operable to vary an effective length of said at least one geometrical crystal filter, thereby to vary said angle-dependent polarization phase-shift.

149. The system of claim 148, wherein said first mechanism is capable of applying a voltage on said at least one geometrical crystal filter, thereby to vary said effective length.

150. The system of claim 148, wherein a shape of said at least one geometrical crystal filter is selected such that when said first mechanism applies a translational motion thereto, said effective length is varied.

151. The system of claim 141, wherein said light deflector is a dynamic grating characterized by a grating equation and further wherein said first mechanism is operable to vary said grating equation, thereby to vary said wavelength-dependent angle, thereby also to vary said angle-dependent polarization phase-shift.

152. The system of claim 140, wherein said at least one geometrical crystal filter is selected from the group consisting of a birefringent crystal and quartz.

153. The system of claim 152, wherein said birefringent crystal is calcite.

154. The system of claim 140, wherein said at least one geometrical crystal filter is selected from the group consisting of at least one on-axis crystal, at least one off-axis crystal and a combination of at least one on-axis crystal and at least one off-axis crystal.

155. The system of claim 126, further comprising a collimator for collimating the light, prior to an impingement of the light on said light deflector.

156. The system of claim 140, further comprising at least one additional geometrical crystal filter, for polarizing the light prior to impinging of the light on said light deflector.

157. The system of claim 126, wherein said decoder is capable of splitting said encoded light beam into two secondary polarized light beams, and calculating a contrast function between said two secondary polarized light beams.

158. The system of claim 126, wherein said decoder is capable of generating a representative time-delay for each of said angle-dependent polarization state, and using said representative time-delay for determining said at least one spectral component of the light.

159. The system of claim 158, wherein said decoder comprises:

(i) a temporal polarization phase-shifter, communicating with an external clock, and capable of accumulating a time-dependent polarization phase-shift to said encoded light beam; and

(ii) a polarization phase-shift analyzer, capable of analyzing said time-dependent polarization phase-shift so as to provide an optical signal having a time-dependent intensity, corresponding to said time-dependent polarization phase-shift.

160. The system of claim 159, wherein said temporal polarization phase-shifter is selected from the group consisting of a liquid crystal light valve and a piezoelectric crystal.

161. The system of claim 160, wherein said piezoelectric crystal is a single resonance piezoelectric crystal.

162. The system of claim 160, wherein said piezoelectric crystal is a multi resonance piezoelectric crystal.

163. The system of claim 160, wherein said piezoelectric crystal is selected from the group consisting of a cubic piezoelectric crystal, a triangular piezoelectric crystal and a hexagonal crystal.

164. The system of claim 160, wherein said piezoelectric crystal is selected from the group consisting of quartz, lithium niobate and lithium tantalate.

165. The system of claim 159, wherein said decoder further comprises an optical converter, for converting said optical signal to electrical signal.

166. The system of claim 165, wherein said optical converter is selected from the group consisting of a charge coupled device, a CMOS detector, a photovoltaic detector, a pin detector, a photodiode, a charge injection device, an image intensifier, a photoconductor detector, an avalanche detector, a photomultiplier and any combination thereof.

167. The system of claim 126, further comprising at least one filter for filtering a portion of the light, prior to an impingement on said deflector, said encoder and/or said decoder.

168. The system of claim 1, further comprising a first anamorphic prism, positioned so as to reduce a spot size of the light prior to impingement of the light on said deflector.

169. The system of claim 1, further comprising a second anamorphic prism, positioned so as to increase angular dispersion of said deflected light beam, prior to impingement of said deflected light beam on said decoder, thereby to optimize a wavelength resolution.

170. The system of claim 126, further comprising a low-resolution optical device, for determining a low-resolution spectral range of the light.

171. The system of claim 140, further comprising a low-resolution optical device, for determining a low-resolution spectral range of the light.

172. The system of claim 171, wherein said low-resolution optical device comprises an additional geometrical crystal filter, and further wherein a free spectral range of said additional geometrical crystal filter is different than a free spectral range of said at least one geometrical crystal filter.

173. The system of claim 172, wherein said free spectral range of said additional geometrical crystal filter is substantially larger than said free spectral range of said at least one geometrical crystal filter.

174. The system of claim 170, wherein said low-resolution optical device is capable of directly using said at least one wavelength-dependent angle so as to determine said low-resolution spectral range.

175. The system of claim 174, wherein said low-resolution optical device is a position sensing device, whereby a position of said deflected light beam corresponds to a respective wavelength-dependent angle.

176. The system of claim 174, wherein said low-resolution optical device is selected from the group consisting of a charge coupled device, a CMOS detector, a photovoltaic detector, a pin detector, a photodiode, a charge injection device, an image intensifier, a photoconductor detector, an avalanche detector and a photomultiplier.

177. The system of claim 126, wherein the de-multiplexing apparatus is characterized by a sub picometer resolution.

178. The system of claim 126, wherein the de-multiplexing apparatus is characterized by a sub nanometer resolution.

179. The system of claim 126, wherein the de-multiplexing apparatus is characterized by a total analysis time of from about 1 nanosecond to a few hours.

180. The system of claim 126, wherein the de-multiplexing apparatus is characterized by a detectivity of from about -80 db to about -0 db.

181. The system of claim 126, serving for sensing changes in environmental conditions, influencing said deflected light beam and/or said encoded light beam.

182. The system of claim 181, wherein said changes in said environmental conditions are selected from the group consisting of vibrations, changes in temperature, changes in pressure, changes in magnetic field and changes in electric field.

183. An apparatus for analyzing light having at least one wavelength, the apparatus comprising, an encoder, a light deflector and a decoder;

said encoder and said light deflector being designed and constructed such that the light is encoded by said encoder to a first set of polarization states, deflected by the deflector to a set of wavelength-dependent angles, reflected back to said encoder, encoded by said encoder to a second set of polarization states and impinges on said decoder;

said decoder being operable to decode said second set of polarization states so as to determine at least one spectral component of the light.

184. The apparatus of claim 183, further comprising:

(d) a mechanism for varying at least one parameter representing at least one of said light deflector and said encoder so as to span a discrete basis of signals, each corresponding to one value of said at least one parameter.

185. The apparatus of claim 184, wherein said decoder is operable to use said discrete basis of signals for determining said at least one spectral component of the light.

186. The apparatus of claim 183, further comprising a beam splitter, for splitting the light into two beams, each having a predetermined polarization.

187. The apparatus of claim 186, wherein said beam splitter comprises a double refraction plate.

188. The apparatus of claim 186, further comprising at least one polarization rotator, designed and configured so as to rotate a polarization of said deflected light beam and/or a polarization of said encoded light beam.

189. The apparatus of claim 183, wherein said light deflector is selected from the group consisting of a grating and a prism.

190. The apparatus of claim 189, wherein said grating is characterized by a first grating equation in a first dimension and a second grating equation in a second dimension.

191. The apparatus of claim 183, wherein said wavelength-dependent angle is characterized by a predetermined dispersion equation.

192. The apparatus of claim 183, wherein said encoder is operable to generate at least one angle-dependent polarization phase-shift, thereby to provide said first and said second sets of polarization states.

193. The apparatus of claim 192, wherein said encoder is calibrated so as to generate a zero or small polarization phase-shift for a predetermined set of wavelengths and a non-zero polarization phase-shift for wavelengths other than said predetermined set of wavelengths.

194. The apparatus of claim 193, wherein said predetermined set of wavelengths comprises a central wavelength and a repetitive set of wavelengths being associated with said central wavelength.

195. The apparatus of claim 192, wherein said polarization phase-shift is selected so as to minimize diffraction effects.

196. The apparatus of claim 192, wherein said angle-dependent polarization phase-shift varies with time.

197. The apparatus of claim 192, wherein said encoder comprises at least one geometrical crystal filter characterized by at least one angle-dependent index of refraction.

198. The apparatus of claim 197, further comprising a first mechanism for varying said angle-dependent polarization phase-shift.

199. The apparatus of claim 198, wherein said first mechanism is operable to rotate said at least one geometrical crystal filter about an axis, so as to vary said angle-dependent polarization phase-shift.

200. The apparatus of claim 199, further comprising a first polarization rotator, for rotating a polarization of said deflected light beam from a first polarization orientation to a second polarization orientation.

201. The apparatus of claim 200, wherein said first polarization rotator is designed and constructed such that said second polarization orientation substantially equals an orientation of said at least one geometrical crystal filter.

202. The apparatus of claim 201, further comprising a second polarization rotator, for rotating a polarization of said encoded light beam from said second polarization orientation to said first polarization orientation.

203. The apparatus of claim 198, wherein said first mechanism is operable to generate a further deflection of the deflected light beam, said further deflection being time-dependent so that said angle-dependent polarization phase-shift varies.

204. The apparatus of claim 203, wherein said first mechanism is a mirror.

205. The apparatus of claim 198, wherein said first mechanism is operable to vary an effective length of said at least one geometrical crystal filter, thereby to vary said angle-dependent polarization phase-shift.

206. The apparatus of claim 205, wherein said first mechanism is capable of applying a voltage on said at least one geometrical crystal filter, thereby to vary said effective length.

207. The apparatus of claim 205, wherein a shape of said at least one geometrical crystal filter is selected such that when said first mechanism applies a translational motion thereto, said effective length is varied.

208. The apparatus of claim 198, wherein said light deflector is a dynamic grating characterized by a grating equation and further wherein said first mechanism is operable to vary said grating equation, thereby to vary said wavelength-dependent angle, thereby also to vary said angle-dependent polarization phase-shift.

209. The apparatus of claim 197, wherein said at least one geometrical crystal filter is selected from the group consisting of a birefringent crystal and quartz.

210. The apparatus of claim 209, wherein said birefringent crystal is calcite.

211. The apparatus of claim 197, wherein said at least one geometrical crystal filter is selected from the group consisting of at least one on-axis crystal, at least one off-axis crystal and a combination of at least one on-axis crystal and at least one off-axis crystal.

212. The apparatus of claim 183, further comprising a collimator for collimating the light, prior to an impingement of the light on said light deflector.

213. The apparatus of claim 183, wherein said decoder is capable of generating a representative time-delay for each polarization state of said second set of

polarization states, and using said representative time-delay for determining said at least one spectral component of the light.

214. The apparatus of claim 213, wherein said decoder comprises:

(i) a temporal polarization phase-shifter, communicating with an external clock, and capable of accumulating a time-dependent polarization phase-shift to each polarization state of said second set of polarization states; and

(ii) a polarization phase-shift analyzer, capable of analyzing said time-dependent polarization phase-shift so as to provide an optical signal having a time-dependent intensity, corresponding to said time-dependent polarization phase-shift.

215. The apparatus of claim 214, wherein said temporal polarization phase-shifter is selected from the group consisting of a liquid crystal light valve and a piezoelectric crystal.

216. The apparatus of claim 215, wherein said piezoelectric crystal is a single resonance piezoelectric crystal.

217. The apparatus of claim 215, wherein said piezoelectric crystal is a multi resonance piezoelectric crystal.

218. The apparatus of claim 215, wherein said piezoelectric crystal is selected from the group consisting of a cubic piezoelectric crystal, a triangular piezoelectric crystal and a hexagonal crystal.

219. The apparatus of claim 215, wherein said piezoelectric crystal is selected from the group consisting of quartz, lithium niobate and lithium tantalate.

220. The apparatus of claim 214, wherein said decoder further comprises an optical converter, for converting said optical signal to electrical signal.

221. The apparatus of claim 220, wherein said optical converter is selected from the group consisting of a charge coupled device, a CMOS detector, a

photovoltaic detector, a pin detector, a photodiode, a charge injection device, an image intensifier, a photoconductor detector, an avalanche detector, a photomultiplier and any combination thereof.

222. The apparatus of claim 183, further comprising at least one filter for filtering a portion of the light, prior to an impingement on said deflector, said encoder and/or said decoder.

223. The apparatus of claim 183, further comprising a first anamorphic prism, positioned so as to reduce a spot size of the light prior to impingement of the light on said deflector.

224. The apparatus of claim 183, further comprising a second anamorphic prism, positioned so as to increase angular dispersion of said deflected light beam, prior to impingement of said deflected light beam on said decoder, thereby to optimize a wavelength resolution.

225. The apparatus of claim 183, further comprising a low-resolution optical device, for determining a low-resolution spectral range of the light.

226. The apparatus of claim 197, further comprising a low-resolution optical device, for determining a low-resolution spectral range of the light.

227. The apparatus of claim 226, wherein said low-resolution optical device comprises an additional geometrical crystal filter, and further wherein a free spectral range of said additional geometrical crystal filter is different than a free spectral range of said at least one geometrical crystal filter.

228. The apparatus of claim 227, wherein said free spectral range of said additional geometrical crystal filter is substantially larger than said free spectral range of said at least one geometrical crystal filter.

229. The apparatus of claim 225, wherein said low-resolution optical device is capable of directly using said at least one wavelength-dependent angle so as to determine said low-resolution spectral range.

230. The apparatus of claim 229, wherein said low-resolution optical device is a position sensing device, whereby a position of said deflected light beam corresponds to a respective wavelength-dependent angle.

231. The apparatus of claim 229, wherein said low-resolution optical device is selected from the group consisting of a charge coupled device, a CMOS detector, a photovoltaic detector, a pin detector, a photodiode, a charge injection device, an image intensifier, a photoconductor detector, an avalanche detector and a photomultiplier.

232. The apparatus of claim 183, characterized by a sub picometer resolution.

233. The apparatus of claim 183, characterized by a sub nanometer resolution.

234. The apparatus of claim 183, wherein a total analysis time of the light is from about 1 nanosecond to a few hours.

235. The apparatus of claim 183, characterized by a detectivity of from about -80 db to about -0 db.

236. The apparatus of claim 183, serving as a component in a wavelength amplifying system.

237. The apparatus of claim 183, serving as a component in an optical sensor.

238. The apparatus of claim 183, serving as a component in a spectrograph.

239. The apparatus of claim 183, serving as a component in an imaging spectrograph.

240. The apparatus of claim 183, serving as a component in a time-frequency spectrograph.

241. The apparatus of claim 183, serving as a component in a telecentric imaging system.

242. The apparatus of claim 183, serving as a component in an optical storage medium.

243. The apparatus of claim 183, serving as a component in an optical communication system.

244. The apparatus of claim 183, serving as a component in a tunable laser system.

245. The apparatus of claim 183, serving as a component in a lithography system.

246. The apparatus of claim 183, serving as a component in an optical computing system.

247. A method of analyzing light having at least one wavelength, the method comprising:

(a) deflecting the light so as to provide a deflected light beam characterized by at least one wavelength-dependent angle, respectively, corresponding to the at least one wavelength of the light;

(b) encoding said deflected light beam so as to provide an encoded light beam characterized by at least one angle-dependent polarization state, respectively, corresponding to said at least one wavelength-dependent angle; and

(c) decoding said encoded light beam so as to determine at least one spectral component of the light.

248. The method of claim 247, further comprising polarizing, at least once, the light prior to said step (a).

249. The method of claim 247, wherein said step (b) is repeated at least once.

250. The method of claim 247, further comprising:

(d) varying at least one parameter representing at least one of said steps (a) and (b) and repeating said steps (a)-(b) at least once so as to span a discrete basis of signals, each corresponding to one value of said at least one parameter; and

(e) using said discrete basis of signals for determining said at least one spectral component of the light.

251. The method of claim 250, wherein said step (e) is done by a mathematical transform.

252. The method of claim 251, wherein said mathematical transform is elected from the group consisting of a Fourier transform, a Gabor transform, a Haar transform, a Hartley transform, a sine transform, a cosine transform, a Hadamard transform and a wavelet transform.

253. The method of claim 247, further comprising splitting the light into two beams, each having a predetermined polarization.

254. The method of claim 253, wherein said splitting the light is by a double refraction plate.

255. The method of claim 247, further comprising rotating a polarization of said deflected light beam and/or a polarization of said encoded light beam.

256. The method of claim 247, wherein said deflecting is by a grating.

257. The method of claim 247, wherein said deflecting is by a prism.

258. The method of claim 256, wherein said grating is characterized by a first grating equation in a first dimension and a second grating equation in a second dimension.

259. The method of claim 247, wherein said wavelength-dependent angle is characterized by a predetermined dispersion equation.

260. The method of claim 247, wherein said encoding comprises generating at least one angle-dependent polarization phase-shift, thereby providing said angle-dependent polarization state.

261. The method of claim 260, wherein said generating said at least one angle-dependent polarization phase-shift is done so as to generate a zero or small polarization phase-shift for a predetermined set of wavelengths and a non-zero polarization phase-shift for wavelengths other than said predetermined set of wavelengths.

262. The method of claim 261, wherein said predetermined set of wavelengths comprises a central wavelength and a repetitive set of wavelengths being associated with said central wavelength.

263. The method of claim 260, wherein said polarization phase-shift is selected so as to minimize diffraction effects.

264. The method of claim 260, further comprising varying said angle-dependent polarization phase-shift varies with time.

265. The method of claim 260, wherein said generating said at least one angle-dependent polarization phase-shift is by at least one geometrical crystal filter characterized by at least one angle-dependent index of refraction.

266. The method of claim 265, further comprising varying said angle-dependent polarization phase-shift.

267. The method of claim 266, wherein said varying said angle-dependent polarization phase-shift is by rotating said at least one geometrical crystal filter.

268. The method of claim 267, further comprising rotating a polarization of said deflected light beam from a first polarization orientation to a second polarization orientation.

269. The method of claim 268, wherein said rotating said polarization of said deflected light is such that said second polarization orientation substantially equals an orientation of said at least one geometrical crystal filter.

270. The method of claim 269, further comprising rotating a polarization of said encoded light beam from said second polarization orientation to said first polarization orientation.

271. The method of claim 266, wherein said varying said angle-dependent polarization phase-shift is by generating a further deflection of the deflected light beam, said further deflection being time-dependent.

272. The method of claim 271, wherein said generating said further deflection is by a mirror.

273. The method of claim 266, wherein said varying said angle-dependent polarization phase-shift is by varying an effective length of said at least one geometrical crystal filter.

274. The method of claim 273, wherein said varying said effective length is by applying a voltage on said at least one geometrical crystal filter.

275. The method of claim 273, wherein a shape of said at least one geometrical crystal filter is selected such that when a translational motion is applied thereto, said effective length is varied.

276. The method of claim 273, wherein said varying said effective length is by applying said translational motion to said at least one geometrical crystal filter.

277. The method of claim 266, wherein said deflecting is by a dynamic grating characterized by a grating equation and further wherein said varying said angle-dependent polarization phase-shift is by varying said grating equation, thereby varying said wavelength-dependent angle, thereby also varying said angle-dependent polarization phase-shift.

278. The method of claim 266, wherein said decoding said encoded light beam is by obtaining a plurality of parameters, each corresponding to one angle dependent polarization phase-shift, and analyzing said plurality of parameters thereby decoding said encoded light beam.

279. The method of claim 278, wherein said analyzing said plurality of parameters is by linear decomposition.

280. The method of claim 266, wherein said analyzing said plurality of parameters is by linear prediction.

281. The method of claim 266, wherein said analyzing said plurality of parameters is by a maximum entropy method.

282. The method of claim 266, wherein said analyzing said plurality of parameters is by harmonic inversion.

283. The method of claim 265, wherein said at least one geometrical crystal filter is selected from the group consisting of a birefringent crystal and quartz.

284. The method of claim 283, wherein said birefringent crystal is calcite.

285. The method of claim 265, wherein said at least one geometrical crystal filter is selected from the group consisting of at least one on-axis crystal, at least one off-axis crystal and a combination of at least one on-axis crystal and at least one off-axis crystal.

286. The method of claim 247, further comprising collimating the light, prior to an impingement of the light on said light deflector.

287. The method of claim 265, further comprising polarizing the light prior to impinging of the light on said light deflector.

288. The method of claim 247, further comprising splitting said encoded light beam into two secondary polarized light beams, and calculating a contrast function between said two secondary polarized light beams.

289. The method of claim 247, wherein said decoding said encoded light beam is by a mathematical transform.

290. The method of claim 289, wherein said mathematical transform is elected from the group consisting of a Fourier transform, a Gabor transform, a Haar transform, a Hartley transform, a sine transform, a cosine transform, a Hadamard transform and a wavelet transform.

291. The method of claim 247, wherein said decoding said encoded light beam is by a calibration table.

292. The method of claim 247, wherein said decoding said encoded light beam is by least square fitting.

293. The method of claim 247, wherein said decoding said encoded light beam is by a compensated pseudo-phase method.

294. The method of claim 247, further comprising generating a representative time-delay for each of said angle-dependent polarization state, and using said representative time-delay for determining said at least one spectral component of the light.

295. The method of claim 294, wherein said decoding comprises:

(i) accumulating a time-dependent polarization phase-shift to said encoded light beam; and

(ii) analyzing said time-dependent polarization phase-shift so as to provide an optical signal having a time-dependent intensity, corresponding to said time-dependent polarization phase-shift.

296. The method of claim 295, wherein said accumulating said time-dependent polarization phase-shift is by an optical element selected from the group consisting of a liquid crystal light valve and a piezoelectric crystal.

297. The method of claim 296, wherein said piezoelectric crystal is a single resonance piezoelectric crystal.

298. The method of claim 296, wherein said piezoelectric crystal is a multi resonance piezoelectric crystal.

299. The method of claim 296, wherein said piezoelectric crystal is selected from the group consisting of a cubic piezoelectric crystal, a triangular piezoelectric crystal and a hexagonal crystal.

300. The method of claim 296, wherein said piezoelectric crystal is selected from the group consisting of quartz, lithium niobate and lithium tantalate.

301. The method of claim 295, further comprising converting said optical signal to electrical signal.

302. The method of claim 301, wherein said converting said optical signal to electrical signal is by an optical converter selected from the group consisting of a charge coupled device, a CMOS detector, a photovoltaic detector, a pin detector, a photodiode, a charge injection device, an image intensifier, a photoconductor detector, an avalanche detector, a photomultiplier and any combination thereof.

303. The method of claim 247, further comprising filtering a portion of the light, prior to said step of deflecting, said step of encoding and/or said step of decoding.

304. The method of claim 247, further comprising reducing a spot size of the light prior to said step of deflecting.

305. The method of claim 247, further comprising increasing angular dispersion of said deflected light beam, prior to said step of decoding, thereby optimizing a wavelength resolution.

306. The method of claim 247, further comprising determining a low-resolution spectral range of the light.

307. The method of claim 265, further comprising determining a low-resolution spectral range of the light.

308. The method of claim 307, wherein said determining said low-resolution spectral range of the light is by an additional geometrical crystal filter having a free spectral range which is different than a free spectral range of said at least one geometrical crystal filter.

309. The method of claim 308, wherein said free spectral range of said additional geometrical crystal filter is substantially larger than said free spectral range of said at least one geometrical crystal filter.

310. The method of claim 306, wherein said determining said low-resolution spectral range is by directly using said at least one wavelength-dependent angle.

311. The method of claim 310, wherein said directly using said at least one wavelength-dependent angle is by a position sensing device, whereby a position of said deflected light beam corresponds to a respective wavelength-dependent angle.

312. The method of claim 310, wherein said position sensing device is selected from the group consisting of a charge coupled device, a CMOS detector, a photovoltaic detector, a pin detector, a photodiode, a charge injection device, an image intensifier, a photoconductor detector, an avalanche detector and a photomultiplier.

313. The method of claim 247, wherein the analysis of the light is characterized by a sub picometer resolution.

314. The method of claim 247, wherein the analysis of the light is characterized by a sub nanometer resolution.

315. The method of claim 247, wherein a total analysis time of the light is from about 1 nanosecond to a few hours.

316. The method of claim 247, wherein the analysis of the light is characterized by a detectivity of from about -80 db to about -0 db.

317. The method of claim 247, further comprising sensing changes in environmental conditions, influencing said deflected light beam and/or said encoded light beam.

318. The method of claim 317, wherein said changes in said environmental conditions are selected from the group consisting of vibrations, changes in temperature, changes in pressure, changes in magnetic field and changes in electric field.

319. A method of measuring a wavelength of a monochromatic light, the method comprising:

- (a) deflecting the monochromatic light at a wavelength-dependent angle;
- (b) encoding the monochromatic light according to said wavelength-dependent angle thereby providing an encoded light beam; and
- (c) decoding said encoded light beam so as to determine the wavelength of the monochromatic light.

320. The method of claim 319, further comprising polarizing, at least once, the monochromatic light prior to said step (a).

321. The method of claim 319, wherein said step (b) is repeated at least once.

322. The method of claim 319, further comprising:

- (d) varying at least one parameter representing at least one of said steps (a) and (b) and repeating said steps (a)-(b) at least once so as to span a discrete basis of signals, each corresponding to one value of said at least one parameter; and
- (e) using said discrete basis of signals for determining the wavelength of the monochromatic light.

323. The method of claim 322, wherein said step (e) is done by a mathematical transform.

324. The method of claim 323, wherein said mathematical transform is elected from the group consisting of a Fourier transform, a Gabor transform, a Haar transform, a Hartley transform, a sine transform, a cosine transform, a Hadamard transform and a wavelet transform.

325. The method of claim 319, further comprising splitting the monochromatic light into two beams, each having a predetermined polarization.

326. The method of claim 325, wherein said splitting the monochromatic light is by a double refraction plate.

327. The method of claim 319, further comprising rotating a polarization of said deflected light beam and/or a polarization of said encoded light beam.

328. The method of claim 319, wherein said deflecting is by a grating.

329. The method of claim 319, wherein said deflecting is by a prism.

330. The method of claim 328, wherein said grating is characterized by a first grating equation in a first dimension and a second grating equation in a second dimension.

331. The method of claim 319, wherein said wavelength-dependent angle is characterized by a predetermined dispersion equation.

332. The method of claim 319, wherein said encoding comprises generating at least one angle-dependent polarization phase-shift, thereby providing said angle-dependent polarization state.

333. The method of claim 332, wherein said generating said at least one angle-dependent polarization phase-shift is done so as to generate a zero or small polarization phase-shift for a predetermined set of wavelengths and a non-zero polarization phase-shift for wavelengths other than said predetermined set of wavelengths.

334. The method of claim 333, wherein said predetermined set of wavelengths comprises a central wavelength and a repetitive set of wavelengths being associated with said central wavelength.

335. The method of claim 332, wherein said polarization phase-shift is selected so as to minimize diffraction effects.

336. The method of claim 332, wherein said generating said at least one angle-dependent polarization phase-shift is by at least one geometrical crystal filter characterized by at least one angle-dependent index of refraction.

337. The method of claim 332, wherein said at least one geometrical crystal filter is selected from the group consisting of a birefringent crystal and quartz.

338. The apparatus of claim 336, wherein said birefringent crystal is calcite.

339. The method of claim 336, wherein said at least one geometrical crystal filter is selected from the group consisting of at least one on-axis crystal, at least one off-axis crystal and a combination of at least one on-axis crystal and at least one off-axis crystal.

340. The method of claim 319, further comprising collimating the monochromatic light, prior to an impingement of the monochromatic light on said light deflector.

341. The method of claim 336, further comprising polarizing the monochromatic light prior to impinging of the monochromatic light on said light deflector.

342. The method of claim 319, further comprising splitting said encoded light beam into two secondary polarized light beams, and calculating a contrast function between said two secondary polarized light beams.

343. The method of claim 319, wherein said decoding said encoded light beam is by a mathematical transform.

344. The method of claim 343, wherein said mathematical transform is elected from the group consisting of a Fourier transform, a Gabor transform, a Haar transform, a Hartley transform, a sine transform, a cosine transform, a Hadamard transform and a wavelet transform.

345. The method of claim 319, wherein said decoding said encoded light beam is by a calibration table.

346. The method of claim 319, wherein said decoding said encoded light beam is by least square fitting.

347. The method of claim 319, wherein said decoding said encoded light beam is by a compensated pseudo-phase method.

348. The method of claim 319, further comprising generating a representative time-delay for each of said angle-dependent polarization state, and using said representative time-delay for determining the wavelength of the monochromatic light.

349. The method of claim 348, wherein said decoding comprises:

(i) accumulating a time-dependent polarization phase-shift to said encoded light beam; and

(ii) analyzing said time-dependent polarization phase-shift so as to provide an optical signal having a time-dependent intensity, corresponding to said time-dependent polarization phase-shift.

350. The method of claim 349, wherein said accumulating said time-dependent polarization phase-shift is by an optical element selected from the group consisting of a liquid crystal light valve and a piezoelectric crystal.

351. The method of claim 350, wherein said piezoelectric crystal is a single resonance piezoelectric crystal.

352. The method of claim 350, wherein said piezoelectric crystal is a multi resonance piezoelectric crystal.

353. The method of claim 350, wherein said piezoelectric crystal is selected from the group consisting of a cubic piezoelectric crystal, a triagonal piezoelectric crystal and a hexagonal crystal.

354. The method of claim 350, wherein said piezoelectric crystal is selected from the group consisting of quartz, lithium niobate and lithium tantalate.

355. The method of claim 349, further comprising converting said optical signal to electrical signal.

356. The method of claim 355, wherein said converting said optical signal to electrical signal is by an optical converter selected from the group consisting of a charge coupled device, a CMOS detector, a photovoltaic detector, a pin detector, a photodiode, a charge injection device, an image intensifier, a photoconductor detector, an avalanche detector, a photomultiplier and any combination thereof.

357. The method of claim 319, further comprising filtering a portion of the light, prior said step of deflecting, said step of encoding and/or said step of decoding.

358. The method of claim 319, further comprising reducing a spot size of the light prior to said step of deflecting.

359. The method of claim 319, further comprising increasing angular dispersion of said deflected light beam, prior to said step of decoding, thereby optimizing a wavelength resolution.

360. The method of claim 319, further comprising determining a low-resolution spectral range of the monochromatic light.

361. The method of claim 336, further comprising determining a low-resolution spectral range of the monochromatic light.

362. The method of claim 361, wherein said determining said low-resolution spectral range of the monochromatic light is by an additional geometrical crystal filter having a free spectral range which is different than a free spectral range of said at least one geometrical crystal filter.

363. The method of claim 362, wherein said free spectral range of said additional geometrical crystal filter is substantially larger than said free spectral range of said at least one geometrical crystal filter.

364. The method of claim 360, wherein said determining said low-resolution spectral range is by directly using said at least one wavelength-dependent angle.

365. The method of claim 364, wherein said directly using said at least one wavelength-dependent angle is by a position sensing device, whereby a position of said deflected light beam corresponds to a respective wavelength-dependent angle.

366. The method of claim 364, wherein said position sensing device is selected from the group consisting of a charge coupled device, a CMOS detector, a photovoltaic detector, a pin detector, a photodiode, a charge injection device, an image intensifier, a photoconductor detector, an avalanche detector and a photomultiplier.

367. The method of claim 319, wherein the analysis of the monochromatic light is characterized by a sub picometer resolution.

368. The method of claim 319, wherein the analysis of the monochromatic light is characterized by a sub nanometer resolution.

369. The method of claim 319, wherein a total analysis time of the monochromatic light is from about 1 nanosecond to a few hours.

370. The method of claim 319, wherein the analysis of the monochromatic light is characterized by a detectivity of from about -80 db to about -0 db.

371. The method of claim 319, further comprising sensing changes in environmental conditions, influencing said wavelength-dependent angle and/or said encoded light beam.

372. The method of claim 371, wherein said changes in said environmental conditions are selected from the group consisting of vibrations, changes in temperature, changes in pressure, changes in magnetic field and changes in electric field.

373. A Bragg sensor system for detecting vibrations, the system having an apparatus for analyzing light having at least one wavelength, the apparatus comprising:

- (a) a light deflector for deflecting the light so as to provide a deflected light beam characterized by a plurality of wavelength-dependent angles, respectively, corresponding to the plurality of wavelengths of the optical signal;

- (b) an encoder, capable of encoding said deflected light beam so as to provide an encoded light beam characterized by a plurality of angle-dependent polarization states, respectively, corresponding to said plurality of wavelength-dependent angles; and

- (c) a decoder, for decoding said encoded light beam so as to determine the plurality of wavelengths of the optical signal, thereby to detect vibrations of said light deflector and/or said encoder.

374. The system of claim 373, further comprising:

- (d) a mechanism for varying at least one parameter representing at least one of said light deflector and said encoder so as to span a discrete basis of signals, each corresponding to one value of said at least one parameter.

375. The system of claim 374, wherein said decoder is operable to use said discrete basis of signals for determining the plurality of wavelengths of the optical signal.

376. The system of claim 373, further comprising a beam splitter, for splitting the light into two beams, each having a predetermined polarization.

377. The system of claim 376, wherein said beam splitter comprises a double refraction plate.

378. The system of claim 376, further comprising at least one polarization rotator, designed and configured so as to rotate a polarization of said deflected light beam and/or a polarization of said encoded light beam.

379. The system of claim 373, wherein said light deflector is selected from the group consisting of a grating and a prism.

380. The system of claim 379, wherein said grating is characterized by a first grating equation in a first dimension and a second grating equation in a second dimension.

381. The system of claim 373, wherein said wavelength-dependent angle is characterized by a predetermined dispersion equation.

382. The system of claim 373, wherein said encoder is operable to generate at least one angle-dependent polarization phase-shift, thereby to provide said angle-dependent polarization state.

383. The system of claim 382, wherein said encoder is calibrated so as to generate a zero or small polarization phase-shift for a predetermined set of wavelengths and a non-zero polarization phase-shift for wavelengths other than said predetermined set of wavelengths.

384. The system of claim 382, wherein said predetermined set of wavelengths comprises a central wavelength and a repetitive set of wavelengths being associated with said central wavelength.

385. The system of claim 382, wherein said polarization phase-shift is selected so as to minimize diffraction effects.

386. The system of claim 382, wherein said angle-dependent polarization phase-shift varies with time.

387. The system of claim 382, wherein said encoder comprises at least one geometrical crystal filter characterized by at least one angle-dependent index of refraction.

388. The system of claim 387, further comprising a first mechanism for varying said angle-dependent polarization phase-shift.

389. The system of claim 388, wherein said first mechanism is operable to rotate said at least one geometrical crystal filter about an axis, so as to vary said angle-dependent polarization phase-shift.

390. The system of claim 389, further comprising a first polarization rotator, for rotating a polarization of said deflected light beam from a first polarization orientation to a second polarization orientation.

391. The system of claim 390, wherein said first polarization rotator is designed and constructed such that said second polarization orientation substantially equals an orientation of said at least one geometrical crystal filter.

392. The system of claim 391, further comprising a second polarization rotator, for rotating a polarization of said encoded light beam from said second polarization orientation to said first polarization orientation.

393. The system of claim 388, wherein said first mechanism is operable to generate a further deflection of the deflected light beam, said further deflection being time-dependent so that said angle-dependent polarization phase-shift varies.

394. The system of claim 393, wherein said first mechanism is a mirror.

395. The system of claim 388, wherein said first mechanism is operable to vary an effective length of said at least one geometrical crystal filter, thereby to vary said angle-dependent polarization phase-shift.

396. The system of claim 395, wherein said first mechanism is capable of applying a voltage on said at least one geometrical crystal filter, thereby to vary said effective length.

397. The system of claim 395, wherein a shape of said at least one geometrical crystal filter is selected such that when said first mechanism applies a translational motion thereto, said effective length is varied.

398. The system of claim 388, wherein said light deflector is a dynamic grating characterized by a grating equation and further wherein said first mechanism is operable to vary said grating equation, thereby to vary said wavelength-dependent angle, thereby also to vary said angle-dependent polarization phase-shift.

399. The system of claim 387, wherein said at least one geometrical crystal filter is selected from the group consisting of a birefringent crystal and quartz.

400. The system of claim 398, wherein said birefringent crystal is calcite.

401. The system of claim 387, wherein said at least one geometrical crystal filter is selected from the group consisting of at least one on-axis crystal, at least one off-axis crystal and a combination of at least one on-axis crystal and at least one off-axis crystal.

402. The system of claim 373, further comprising a collimator for collimating the light, prior to an impingement of the light on said light deflector.

403. The system of claim 387, further comprising at least one additional geometrical crystal filter, for polarizing the light prior to impinging of the light on said light deflector.

404. The system of claim 373, wherein said decoder is capable of splitting said encoded light beam into two secondary polarized light beams, and calculating a contrast function between said two secondary polarized light beams.

405. The system of claim 373, wherein said decoder is capable of generating a representative time-delay for each of said angle-dependent polarization state, and using said representative time-delay for determining said at least one spectral component of the light.

406. The system of claim 405, wherein said decoder comprises:

(i) a temporal polarization phase-shifter, communicating with an external clock, and capable of accumulating a time-dependent polarization phase-shift to said encoded light beam; and

(ii) a polarization phase-shift analyzer, capable of analyzing said time-dependent polarization phase-shift so as to provide an optical signal having a time-dependent intensity, corresponding to said time-dependent polarization phase-shift.

407. The system of claim 406, wherein said temporal polarization phase-shifter is selected from the group consisting of a liquid crystal light valve and a piezoelectric crystal.

408. The system of claim 407, wherein said piezoelectric crystal is a single resonance piezoelectric crystal.

409. The system of claim 407, wherein said piezoelectric crystal is a multi resonance piezoelectric crystal.

410. The system of claim 407, wherein said piezoelectric crystal is selected from the group consisting of a cubic piezoelectric crystal, a triagonal piezoelectric crystal and a hexagonal crystal.

411. The system of claim 407, wherein said piezoelectric crystal is selected from the group consisting of quartz, lithium niobate and lithium tantalate.

412. The system of claim 406, wherein said decoder further comprises an optical converter, for converting said optical signal to electrical signal.

413. The system of claim 412, wherein said optical converter is selected from the group consisting of a charge coupled device, a CMOS detector, a photovoltaic detector, a pin detector, a photodiode, a charge injection device, an image intensifier, a photoconductor detector, an avalanche detector, a photomultiplier and any combination thereof.

414. The apparatus of claim 373, further comprising at least one filter for filtering a portion of the light, prior to an impingement on said deflector, said encoder and/or said decoder.

415. The apparatus of claim 373, further comprising a first anamorphic prism, positioned so as to reduce a spot size of the light prior to impingement of the light on said deflector.

416. The apparatus of claim 373, further comprising a second anamorphic prism, positioned so as to increase angular dispersion of said deflected light beam, prior to impingement of said deflected light beam on said decoder, thereby to optimize a wavelength resolution.

417. The system of claim 373, further comprising a low-resolution optical device, for determining a low-resolution spectral range of the light.

418. The system of claim 387, further comprising a low-resolution optical device, for determining a low-resolution spectral range of the light.

419. The system of claim 418, wherein said low-resolution optical device comprises an additional geometrical crystal filter, and further wherein a free spectral range of said additional geometrical crystal filter is different than a free spectral range of said at least one geometrical crystal filter.

420. The system of claim 419, wherein said free spectral range of said additional geometrical crystal filter is substantially larger than said free spectral range of said at least one geometrical crystal filter.

421. The system of claim 417, wherein said low-resolution optical device is capable of directly using said at least one wavelength-dependent angle so as to determine said low-resolution spectral range.

422. The system of claim 421, wherein said low-resolution optical device is a position sensing device, whereby a position of said deflected light beam corresponds to a respective wavelength-dependent angle.

423. The system of claim 421, wherein said low-resolution optical device is selected from the group consisting of a charge coupled device, a CMOS detector, a photovoltaic detector, a pin detector, a photodiode, a charge injection device, an image intensifier, a photoconductor detector, an avalanche detector and a photomultiplier.

424. The system of claim 373, wherein the apparatus is characterized by a sub picometer resolution.

425. The system of claim 373, wherein the apparatus is characterized by a sub nanometer resolution.

426. The system of claim 373, wherein the apparatus is characterized by a total analysis time of from about 1 nanosecond to a few hours.

427. The system of claim 373, wherein the apparatus is characterized by a detectivity of from about -80 db to about -0 db.